



STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNDISPLACED SCAPHOID FRACTURE TREATED WITH PERCUTANEOUS HERBERT SCREW FIXATION

Orthopaedics

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ABSTRACT

BACKGROUND: The management of undisplaced fractures of the scaphoid is controversial. Conventional management of these fractures has been with significant risk of scaphoid nonunion.

OBJECTIVES: Our objective was to study if early per-cutaneous fixation of scaphoid fractures results in early return to work and sports activities, better union rates, better pain relief and better range of motion of wrist.

METHODOLOGY: This study examined the results from 30 patients who underwent per-cutaneous screw fixation using a Herbert screw in an un-displaced scaphoid fracture. All patients in the study group were followed up for average 2 years evaluating them according to the Green & O'Brien score.

RESULTS: All had healed successfully after the index procedure. There were three complications consisting of wrist pain and decreased range of motion of wrist. These also went on to heal, resulting in better union rates.

CONCLUSION: Thus per-cutaneous fixation of acute, un-displaced scaphoid fractures with percutaneous Herbert screws is an effective treatment which reduces the need of prolonged immobilization and helps in an early return to the routine activity.

KEYWORDS

Scaphoid, undisplaced, Herbert screw, green & O' Brien score, percutaneous, trabecular

INTRODUCTION

Scaphoid is derived from Greek word "Skaphoeides" and Latin word "Scaphoides" which means "boat" or "like a bowl". But scaphoid looks more like a peanut than a boat (Os Arachisoideum). Scaphoid fracture accounts for almost 60% of all carpal bone fractures. The age group commonly involved is the active young adults resulting mostly due to a fall on an outstretched hand. There can be substantial time off the work, morbidity and loss of earnings. Displaced scaphoid fractures involves risk of avascular necrosis thus surgical management is the well proved treatment modality for them.

Traditionally, management of undisplaced scaphoid fractures has been closed (cast) treatment. Waist fracture of scaphoid with minimal displacement treated with cast immobilization usually heals with good results. But the cast to be used is still debatable. With little evidence of any benefit of using long arm cast with thumb immobilization. Cast immobilisation is given at least for a period of 8 to 12 weeks, which can be prolonged in case of delayed union.

Prolonged cast immobilization involves risk of complications such as delayed or non-unions, mal unions, and joint stiffness due to cast immobilization as well as loss of functional occupational time. Contrary, surgical treatment of scaphoid fractures has given good results which is been reported in several studies. Complications due to surgical treatment of un-displaced scaphoid fractures have been reduced due to a safer and more reliable techniques and implants.

Chief complaint of the patient with scaphoid fracture is wrist pain due to fall or direct trauma. Clinical examination usually with h/o fall on outstretched hand suggests scaphoid fracture injury. It is difficult to diagnose undisplaced scaphoid fracture thus can lead to missed/delayed diagnosis affecting the post-operative outcome.

Complications due to closed reduction and immobilization in cast can be reduced by acute percutaneous fixation. Thus internal fixation can be used for undisplaced fractures with minimally extensive or percutaneous approaches. Thus internal fixation is leading trend for undisplaced scaphoid fracture management. Herbert screw is a percutaneous headless screw with two threaded sections of different pitches which would automatically provide some compression. Percutaneous screws not only accelerate repair due to compression at fracture site, but helps to reduce the factors which may delay healing.

MATERIAL & METHODS

This study has been conducted in Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Rohtas, Bihar with

aim of evaluating the outcome of surgical management of functional and radiological outcome of undisplaced scaphoid fractures treated with percutaneous Herbert screw fixation. All patients with undisplaced fracture of Scaphoid, who are operated with Herbert screws percutaneously were followed up between June 2020 to October 2021.

Inclusion Criteria

1. Patients who have un-displaced fracture of scaphoid bone.
2. Patients willing to give informed verbal and written consent for surgical treatment and ready to follow up.
3. Patients within age group of 15 years to 65 years.

Exclusion Criteria

1. Patients having displaced fracture of scaphoid.
2. Patients not willing of surgical management of the fracture
3. Patients having compound fractures.
4. Age less than 15 years and more than 65 years.

METHODS AND ANALYSIS OF THE RESULTS

Total of 30 patients who were diagnosed with an Undisplaced fracture of the scaphoid bone were operated upon with Herbert screws fixed percutaneously in our hospital are included in this study. X-rays were done immediate post operatively followed by at two, eight, twelve weeks and six months and twelve months after surgery as per patients follow up. Patients will be evaluated according to the modified clinical scoring system of Green and O'Brien and results obtained will be analysed by percentage & proportions, test of proportions and statistical test (z-test) for proportions will be used for analysis.

Investigations

1. All routine Blood investigations.
2. X Rays-Anteroposterior (AP) radiographs of wrist.
- Lateral radiographs of wrist.
- Scaphoid view (wrist in 30o ulnar deviation in pronation)
- Radial deviation radiographs in pronation
3. C.T. scan with 3 D reconstruction if required.
4. Immediate Post-operative X ray.
5. Check X rays at two, eight, twelve weeks and six months after surgery, as per patients follow up and patients economic status.

RESULTS

Pre-operative observation
Sex

Of the 30 patients that were followed up there were 6 females and 24 males.

Age

Patients included in the study group were in the range of 18 yrs and 60 yrs with an average age at the time of surgery being 33.06 yrs.

Duration of symptoms

Patients who had been diagnosed with an acute scaphoid fracture were treated immediately between 1-6 days.

Occupation

The majorities of the patients were sports persons, manual laborers, and also people who met with road traffic accident.

Symptoms

All the 30 patients included in the study group had one or more of the following symptoms.

1. Wrist pain in the anatomical snuff box/scaphoid tubercle.
2. Pain on axial compression of wrist or thumb.
3. Pain on movement of wrist.
4. Swelling over the wrist.

Signs

Patients, on examination had the following signs.

1. Snuffbox and scaphoid tubercle tenderness.
2. Pain with axial compression yielded a sensitivity of 100%.
3. Reduced range of motion with pain at the terminal range of motion.

Operative procedure

All patients were treated by percutaneous Herbert screw fixation either through Volar or Dorsal approach under guidance of image intensifier. Blood loss
Blood loss was minimally present as the approach was a percutaneous approach.

Immediate post-operative protocol

A removable thumb Spica splint application.
Sutures were removed after 10 days post operatively.
Wrist range of motion exercises started as early as possible and as per the patients pain tolerance.

Duration of follow up

The average duration of patient follow up is 12.3 months with the maximum follow up being for 17 months and the least being for 9 months.

Post-operative results:

Of the 30 patients operated:

- 1) 1 patient had ≤50 degrees, 13 patients had 51-70 degrees and 16 patients had >70 degrees of palmar flexion.
- 2) 1 patient had ≤50 degrees, 5 patients had 51-70 degrees and 24 patients had >70 degrees of dorsi flexion.
- 3) 1 patient had 1-5 degrees, 4 patients had 6-10 degrees, 21 patients had 11-15 and 4 patients had 16-20 degrees of radial deviation.
- 4) 1 patient had 1-10 degrees, 11 patients had 11-20 degrees and 18 patients had 11-20 degrees of ulnar deviation.
- 5) 4 patients had fair results, 14 patients had good results and 12 patients had excellent results as per Green and O'Brien wrist scoring system.
- 6) 4 patients had complications-3 had radio-carpal arthritis and 1 had non-union of scaphoid fracture.
- 7) Wrist pain had significantly decreased in all the patients.

Fracture union

The union of fracture was derived only radio graphically after confirming the continuous trabecular pattern and callus formation. Trabecular continuity was not observed in 1 patient, while in 10 patients after 6 weeks, in 8 patients after 7 weeks and in 11 patients after 8 weeks trabecular continuity was observed.

Table 1: Age of patients and post-operative result according to the Green & O'Brien score

Variables	Result		Fisher's Exact Test p value, significant (if p<0.05)
	Excellent	Good and Fair	
Age (yrs.)	Frequency (%)	Frequency (%)	0.010, Significant
19-39	12(100.0)	10(55.6%)	
40-59	0(0.0%)	08(44.4%)	

p = 0.010, significant showing association between age of patients and post-operative outcome. Patients between age group 19yrs to 39 yrs of age had excellent results as compared to patients between age group 40yrs to 59 yrs who had good to fair results.

Table 2: Post-operative Trabecular continuity and results

Variables	Result		Fisher's Exact Test p value, significant (if p<0.05)
	Excellent	Good and Fair	
Radiological trabecular continuity at follow up	Frequency (%)	Frequency (%)	0.001, Significant
≤6 weeks	09(75.0%)	02(11.1%)	
>6 weeks	03(25.0%)	16(88.9%)	

p = 0.001, Significant showing patients having trabecular continuity on or before 6 weeks had excellent results as compared to patients having trabecular continuity after 6 weeks who had good to fair results.

Table 3: Gender and post-operative scores according to Green & O'Brien score

Variables	Result		Fisher's Exact Test p value, significant (if p<0.05)
	Excellent	Good and Fair	
Gender	Frequency (%)	Frequency (%)	0.06, Not Significant
Females	0(0.0%)	05(27.8%)	
Male	12(100.0%)	13(72.2%)	

p = 0.06, not significant showing no association between gender and post-operative results

Table 4: Mode of injury and post-operative score according to Green & O'Brien score

Variables	Result		Fisher's Exact Test p value, significant (if p<0.05)
	Excellent	Good and Fair	
Mode of injury	Frequency (%)	Frequency (%)	0.71, Not Significant
RTA	07(58.3%)	08(44.4%)	
Other	05(41.7%)	10(55.6%)	

(The mode of injury were clubbed into two groups of RTA and other group including FOOH and H/O fall from HT) p= 0.71, not significant showing no association between mode of injury and post-operative result.

Table 5: Associated injuries and Post-operative results

Table 4: Mode of injury and post-operative score according to Green & O'Brien score

Variables	Result		Fisher's Exact Test p value, significant (if p<0.05)
	Excellent	Good and Fair	
Associated injury	Frequency (%)	Frequency (%)	0.66, Not Significant
Present	03(25.0%)	03(16.7%)	
Absent	09(75.0%)	15(83.3%)	

p = 0.66 not significant, showing no association between associated injury and post-operative results.

Table 6: Time from injury to surgery and post-operative result.

Variables	Result		Fisher's Exact Test p value, significant (if p<0.05)
	Excellent	Good and Fair	
Time from Injury to surgery in Days	Frequency (%)	Frequency (%)	1.00, Not Significant
1-3	10(83.3%)	14(77.8%)	
4-6	02(16.7%)	04(22.2%)	

DISCUSSION

Percutaneous or minimal incision fixation of scaphoid was done by Strelis in 1970. This was done through a volar approach with a cannulated headed screw of his design. Strelis achieved a 70% union rate in cases of delayed unions and pseudarthrosis^[1].

Smith JT et al. in 1988 did a study on "Simultaneous fractures of the distal radius and scaphoid". They concluded that these fractures can be successfully treated by reduction of the radius and immobilization by whatever means necessary to maintain an acceptable position. Scaphoid reduction and healing seemed unaffected by the method of

treatment used to treat the distal radius fracture^[2].

Botte MJ et al. in 1988 did a study on "Internal vascularity of the scaphoid in cadavers after insertion of the Herbert screw". They concluded that palmar approach did not disrupt the significant dorsal blood supply, and the dorsal approach was safe provided care was taken to preserve the visible dorsal vascular leash^[3].

Vukov Vet al. in 1988 did a study on "Simultaneous fractures of the distal end of the radius and the scaphoid bone". They concluded that discovery of the simultaneous fracture is important for adequate immobilization. Inadequate treatment, due to an overlooked fracture of the scaphoid bone, can result in a painful wrist joint and, possibly, Sudeck's atrophy^[4].

Wozasek GE, Moser KD in 1991 did a study on "Percutaneous screw fixation for fractures of the scaphoid". Their study, after a mean postoperative time of 82 months, showed that 89% of the recent fractures had united^[5].

Reis FB et al. in 1993 did a study on "Internal fixation of scaphoid injuries using the Herbert screw through a dorsal approach". Twenty-five patients were treated in this manner, and union rates of 100% for acute fractures and 87% for delayed union and nonunion were achieved^[6].

Trumble TE et al. in 1993 published an article on "Long-term results of fracture of the scaphoid. A follow-up study of more than thirty years". In their study of 56 patients, they found that the average age at the time of the treatment was twenty-eight years (range, fifteen to forty-five years). Fifty-two of the fifty-six patients were treated at the time of the fracture; the other four had a non-union when first seen. The rate of non-union for the fresh fractures at the most recent follow-up examination was 10 per cent (five of fifty-two). Dorsal intercalated-segment instability was found in three of the fifty-six patients; all three had a pseudarthrosis and manifest radiocarpal osteoarthrosis. Marked radiocarpal osteoarthrosis developed in only one (2 per cent) of the forty-seven patients who had a healed fracture; it was far more common in the group that had a pseudarthrosis, in which the prevalence was five of nine patients. Manifest osteoarthrosis also seemed to be associated with pain or weakness: it had developed in only three (6 per cent) of the forty-nine patients who did not have any symptoms at the re-examination, compared with three of the seven who had symptoms^[7].

Düppe H et al. in 1994 did a study on "Ipsilateral fractures of the scaphoid and radius". They concluded that internal fixation of the scaphoid in these combined injuries allowed for earlier and more aggressive therapy to maximize wrist and forearm motion^[8].

Khan FA, Harby S. in 1995 did a study on "Fresh scaphoid fractures". Analysis of 45 cases was done they concluded that plaster cast immobilisation is a satisfactory method of treatment for stable-undisplaced fractures, while results in patients with unstable-displaced fractures are poor and they are best treated by early open reduction and internal fixation^[9].

Rettig AC et al. in 1996 did a study on "Internal fixation of acute stable scaphoid fractures in the athlete". They concluded in their study on 12 patients that internal fixation of a scaphoid fracture allows safe and early return to sports when a playing cast is not an acceptable option and when an athlete accepts the risks of surgery^[10].

In 1975, Tim Herbert continued to work on his double-threaded screw at the University of New South Wales. Its manufacture presented difficulties, but he collaborated with a young engineer called Fisher who made the first 100 Herbert screws in his garage from Steinmann pins. After 18 months of experimental work, the first screws were implanted in 1977. A multicentre clinical trial in Australia led to further refinement and the screws became commercially available in 1981. The early results were reported by Herbert and Fisher in 1984. Daly et al. (p. 530) report an even higher rate of union in 26 patients treated by this method; this is especially impressive since 11 of their patients had previously had unsuccessful operations^[11].

A Inoue and Shionoya in 1997 had done a study on "Herbert screw fixation by limited access for acute fractures of the scaphoid" and have shown a shorter time to union and an earlier return to manual labour when acute fixation is compared with conservative treatment^[12].

Haddad FS, Goddard NJ. In 1998 did a pilot study on 15 patients on acute percutaneous scaphoid fixation. They found that union was obtained in all at a mean of 57 days (38 to 71). The range of movement after union was equal to that of the contralateral limb and grip strength was 98% of the contralateral side at three months. Patients were able to return to sedentary work within four days and to manual work within five weeks^[13].

Roolker W et al. in 1999 did a study on "Diagnosis and treatment of scaphoid fractures, can non-union be prevented?" They concluded when a scaphoid fracture is diagnosed within the 1st week followed by plaster immobilization, non-union of the scaphoid could be prevented^[14].

Bond CD et al. in 2001 did a randomised study on military personnel on "Percutaneous screw fixation or cast immobilization for nondisplaced scaphoid fractures". 11 were operated percutaneously and 14 were conservatively treated. Percutaneous cannulated screw fixation of nondisplaced scaphoid fractures resulted in faster radiographic union and return to military duty compared with cast immobilization^[15].

Adolfsson L et al. in 2001 did a study on "Acutrak screw fixation versus cast immobilisation for undisplaced scaphoid waist fractures". They concluded that acute percutaneous internal fixation of undisplaced scaphoid waist fractures using the acutrak screw allows early mobilisation without adverse effects on fracture healing and that operated patients had significantly better range of motion of wrist at 16 weeks follow up^[16].

Saeden B et al. in 2001 did a study on "Fracture of the carpal scaphoid. A prospective, randomised 12-year follow-up comparing operative and conservative treatment". They concluded that operative treatment of an acute fracture of the scaphoid allows early return of function and should be regarded as an alternative to conservative treatment in patients in whom immobilisation in a cast for three months is not acceptable for reasons related to sports, social life or work^[17].

CONCLUSION

Scaphoid fractures are primarily produced due to fall on outstretched hand and in road traffic accidents. Patients with undisplaced scaphoid fractures are usually young and more active and problems are related to function, men are usually affected more than women. The optimal treatment of minimally displaced or nondisplaced fractures of the scaphoid is unclear. Traditionally, management of these fractures has been unpredictable with a significant risk of nonunion when treated conservatively.

Percutaneous headless screw fixation is a well-documented surgical procedure. Undisplaced scaphoid fractures fixed by percutaneous headless screw fixation yield better results than patients treated conservatively. Good range of motion is achieved after fixation. It relieves pain and functional disability experienced by patients. Patients achieve good range of motion. Trabecular continuity is achieved in most of the patients before 8 weeks. Most of the patients had resumed normal daily activities before 3 months. Manual workers (manuals) had a longer time away from work than non-manual employees/individuals who were self-employed (non-manuals)-median of 84 days and 16 days respectively. Time for return to work is less than the conservatively treated patients in literature.

This study suggests that percutaneous headless screw fixation for undisplaced scaphoid fractures, provides satisfactory clinical and radiographic outcomes after an intermediate duration follow up. Even though the procedure is not free of complications, the overall functional and clinical outcome had shown good results.

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